

Abstract of the Invention

Methods for spatially resolved spin resonance detection in a sample of material, with a resolution as small as $0.5\text{ }\mu\text{m} - 1\text{ mm}$. In one embodiment, a coupler having at least one pair of degenerate orthogonal modes provides an evanescent input signal along one coupler axis to the sample, to which a magnetic field is applied, and senses a spin interaction signal along another coupler axis. In another embodiment, an evanescent input signal is applied to the sample along one of two identical transmission line resonators, and a difference of the two resonator signals provides a spin interaction signal. In another embodiment, a polarized laser beam provides an evanescent input signal to the sample, and the spin interaction signal is sensed according to a second beam polarization direction. Certain ferromagnetic or ferrimagnetic molecules, such as YIG, can be used to tag selected chemical and biological molecules, using spatially resolved spin resonance detection for interrogation.

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